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Nonlinear Response of Pacific Northwest Estuaries to Changing Hydroclimatic Conditions: Flood Frequency, Recovery Time, and Resilience

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Pacific Northwest (PNW) estuarine soft-sediment habitats are productive systems that play an important role in the biodiversity and functioning of coastal ecosystems and provide economically important biotic resources and diverse ecosystem services. Rainfall intensity is on the rise, and the sediment yield from PNW basins has increased. Consequently, sediment input to estuaries has increased in magnitude and intensity, and the input rate of fine-grained sediment from the surrounding drainage basin is likely to have important effects on estuarine ecosystem services. It also may interact nonlinearly to impact the structure and function of intertidal benthic communities and facilitate colonization by non-indigenous species (NIS).

The investigators conducted a manipulative field study simulating different frequencies of flood sedimentation events (zero, one, or two events in a single rain season) and tracked the initial mortality and recovery of the benthic community from these events using a combination of high resolution benthic sampling and univariate and multivariate analyses of benthic community metrics. Particular emphasis has been placed on identifying changes in functional biodiversity, documenting recovery times and potential hysteresis effects of having two sedimentation events in a rain season, tracking mortality and recovery of important functional groups, and changes to the populations of NIS. Parallel sediment samples were collected and analyzed to track changes in important sediment properties that have direct or indirect effects on survival or habitat suitability to the benthic community.

This study will develop an empirical and theoretical framework for predicting the effects of flood sedimentation events on tideflat macrobenthic communities in PNW estuaries and how these changes affect ecologically and economically important biotic resources and ecosystem services. This research will be used to quantify the resilience of intertidal benthic communities and identify important structural changes that may indicate a threshold or catastrophic shift in the benthic ecosystem in response to sedimentation events. Because neither sufficient data nor models currently exist to conduct risk analyses, these datasets will significantly improve our ability to perform ecorisk assessments in PNW estuaries, which can be used by resource managers to make better informed decisions regarding actions to minimize or eliminate the risks to these systems.

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